Appendix C

Biological Opinions, Commitments, and Authorizations

Water Quality. Water quality in Puget Sound is degraded (Puget Sound Partnership 2006; 2008). For example, toxic chemicals in Puget Sound persist and build- up in marine organisms including SRKWs and their prey despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills.

Prey Quantity, Quality, and Availability. Most wild salmon stocks throughout the Northwest are at fractions of their historical levels. Since 1994, NMFS has listed 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California as threatened or endangered under the ESA. Overfishing, habitat loss, and hatchery practices are major causes of decline. Poor ocean conditions over the past two decades have also reduced wild populations. While wild salmon stocks have declined, hatchery production has been generally strong. Total Chinook salmon abundances increased significantly from the mid-1990s to the early 2000s, but have declined in the last several years (PFMC 2008).

Contaminants and pollution also affect the quality of SRKW prey in Puget Sound. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment, these substances accumulate up the food chain and reach high levels in long-lived apex predators like SRKWs. The size of Chinook salmon is also an important aspect of prey quality. In addition, vessels and sound may reduce the effective zone of echolocation and reduce availability of fish for SRKWs in their critical habitat (Holt 2008).

Passage. The SRKWs are highly mobile and use a variety of areas for foraging and migration. Human activities can interfere with movements of the whales and impact their passage. In particular, vessels and acoustic disturbance may present obstacles to whale passage, causing the whales to swim further and change direction more often. This increases energy expenditure and impacts foraging behavior (NMFS 2011b).

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Possession Sound

Possession Sound is within the Whidbey Basin of Puget Sound. Human activities have degraded habitat in the basin through excessive sedimentation, failing septic systems, bulkheads, water quality degradation, and interruption of shoreline sediment sources and long shore transport processes. Approximately 22.5 percent of the Whidbey Basin shoreline is armored, particularly in the cities of Mukilteo and Everett and along the three miles of BNSF railroad between the two cities. The Whidbey Basin also has areas of low dissolved oxygen. Possession Sound is one of eight locations Ecology considers of highest concern for eutrophication. Human activities have degraded sediment quality. Nine percent of the Whidbey Basin marine area exceeds the state's sediment quality standards and the cleanup screening levels for one or more contaminants (PSP 2008).

Possession Sound has significant vessel traffic. In addition to the multiple daily runs of WSF vessels, Possession Sound also has large vessels using the Port of Everett and the Naval Station Everett, commercial fishing boats, and numerous smaller recreational boats. Background noise levels due to vessel traffic at the terminal exceed the 120 dBrms behavioral disturbance threshold for marine mammals. Laughlin (2011) reported background noise levels at the Mukilteo Ferry Terminal within the functional hearing range for SRKWs (122 dB_{rms}), Steller sea lions (122 dB_{rms}), and for humpback whales at (124 dB_{rms}).

Juvenile Chinook salmon use the area as they migrate out of their natal streams and rivers. In 1986 and 1987, a beach seine station within the action area near Mukilteo was sampled weekly from April through July. Juvenile Puget Sound Chinook salmon were more abundant than other salmonid species. Chinook salmon entered the area in low numbers beginning in late April, peaked in mid-May to early June and continued in moderate to high numbers through mid-July.

Eight years of beach seine data in Skagit Bay indicates that wild juvenile Chinook are most abundant along the shoreline between May and July, then decrease in August. Wild sub-yearling Chinook were captured infrequently in Skagit Bay during beach seining efforts in September and October. A nearly identical pattern was observed in Bellingham Bay where monthly sampling continued through December (Rice 2004). The Bellingham Bay research captured two juvenile Chinook in 14 sets in September, and no juvenile Chinook were captured between October and December. Similarly, tow-net sampling in deeper portions of the nearshore reveal a consistent downward trend in Chinook abundance in Skagit Bay between June and October (Rice et al. 2001). Tow-net sampling in Bellingham Bay also documented a summer peak and few juvenile Chinook captured in October (Beamer et al. 2003). No tow-net sampling was conducted in Bellingham Bay during September. In comparison to the beach seine results, juvenile Chinook presence in the Skagit Bay tow-net samples persisted later in the year (Rice et al. 2001). Tow-net sampling by Rice et al. (2011) showed that juvenile Chinook salmon presence in deeper nearshore areas of the Whidbey Basin peaks from July to September and that the majority of these fish are unmarked (and presumably wild).

There are no natal streams in the area of the Mukilteo Ferry Terminal that support Puget Sound steelhead. However, major river systems that support winter and summer steelhead include the Snohomish River (approximately 7 miles north), Stillaguamish River (approximately 15 shoreline miles north), Skagit River (approximately 20 shoreline miles north), and the Duwamish/Green River (approximately 30 shoreline miles south). In addition, numerous small streams in the Sinclair/Dyes Inlets and southern Puget Sound rivers and streams support winter steelhead.

Tow-net sampling (deeper nearshore) and beach seine sampling (shallow nearshore) around Puget Sound have found few steelhead. In tow-net sampling in north and south Puget Sound, NMFS captured a total of 18 steelhead (Rice, unpublished data). Although the total sampling data was not available, the mean steelhead catch ranged from 0 to 0.2 per net in north Puget Sound and 0.1 to 0.8 per net in south Puget Sound.

During 2001 and 2002, beach seining conducted in central Puget Sound by King County Department of Natural Resources captured only nine steelhead out of a total of approximately 34,000 juvenile salmonids (Brennan et al. 2004). Beach seine sampling in Bellingham Bay (north Puget Sound) also captured few steelhead (Lummi Nation, unpublished data). The Bellingham Bay research reported the capture of two juvenile steelhead salmon in 336 sets between February 14 and December 1, 2003. The steelhead were captured in the eastern portion of Bellingham Bay near the Taylor Avenue Dock on June 12 and June 25, 2003.

Southern resident killer whales, Steller sea lions, and humpback whales are likely to be present within the action area in Possession Sound. The Whale Museum manages a long-term database of SRKW sightings and geospatial locations in inland waters of Washington. While these data are predominately opportunistic sightings from a variety of sources (public reports, commercial whale watching, Soundwatch, Lime Kiln State Park land-based observations, and independent research reports), SRKW are highly visible in inland waters and widely followed by the interested public and research community. The dataset does not account for level of observation effort by season or location. However, it is the most comprehensive long-term dataset available to evaluate broad scale habitat use by SRKWs in inland waters. For these reasons, NMFS relies on the number of past sightings to assess the likelihood of SRKW presence in a project area and during work windows. A review of this dataset from the years 1990 to 2008 indicates that SRKW have used the project vicinity during the months that in-water construction activities are proposed (Table 2).

Table 2. Total killer whale sightings per month in the project action area between 1990 and 2008. Months corresponding to the in-water work window are highlighted in green.

Month	Number of sightings
July	0
August	3
September	5
October	20
November	20
December	22
January	18
February	7
March	15
April	7
May	14
June	0

NMFS has limited information about humpback whale foraging habits and space use in inside waters of Washington, and do not have specific fine-scale information for the project area. In recent years, humpback whales are sighted with increasing frequency in the inside waters of Washington, including Puget Sound, primarily during the fall and spring. However, occurrence is uncommon.

Steller sea lions can occur in Washington waters throughout the year. There are no breeding rookeries in Washington. Occurrence in inland waters of Washington is limited to male and sub-adult Steller sea lions in fall, winter, and spring months. Steller sea lions use haul-out locations in coastal and inland waters of Washington. The number of haul-out sites has increased in recent years. The closest documented haul out sites to the Mukilteo Ferry Terminal are the Rich Passage buoys near Manchester, approximately 19 miles southwest of the terminal (haul out #361/362) and Craven Rock, east of Marrowstone Island, approximately 23 miles northwest of the terminal (haul out #232). Generally, the Craven Rock haul out is occupied from October to May. From June to September, most Steller sea lions are at the Oregon or British Columbia rookeries or on the Washington coast haul out site.

There are also observer accounts of one to two Steller sea lions hauled out in Port Gardner near Everett, which is approximately 7 miles northeast of the terminal. Vessel-based sightings of Steller sea lions swimming in the passage between the Kingston and Edmonds Ferry Terminals (approximately 12 miles south of the Mukilteo Ferry Terminal) and in Useless Bay (approximately 11 miles west of the terminal) were recorded in the mid-1980s (NMML, unpublished data).

Existing Terminal

Substrates in the vicinity of the ferry terminal consist of coarse grained sand, gravel, and cobble. The beach is gently sloped. The shoreline has little vegetation and steep retaining walls and riprap. The WSF conducted an eelgrass survey in 2011 and found only one small eelgrass patch (less than one square foot) just east of the existing terminal. Possession Sound is classified as extraordinary for aquatic life use per WAC 173-201A-612. No parameters of concern have been identified in Washington State Department of Ecology's (Ecology) 2008 303(d) list.

The existing terminal covers 8,120 square feet of marine water and contains 248 creosote piles. The existing fishing pier covers 2,000 square feet of marine water and contains 42 creosote piles. The creosote piles degrade water quality in the action area by releasing polycyclic aromatic hydrocarbons (PAHs) into the marine environment. Water quality is a component of both SRKW and PS Chinook salmon (PCE 5) critical habitat. In addition to water quality effects, the pier is also a barrier to juvenile Chinook salmon migration which further degrades PCE 5 of PS Chinook salmon critical habitat.

New Terminal Location

The proposed terminal site is on the Tank Farm property which consists of approximately 20 acres of upland and 13 acres of adjacent offshore property. The upland portion of the property is

12 feet above mean sea level and is graded and flat. A protective riprap wall, approximately ten feet high, separates the property from Possession Sound. Vegetation on the property is almost entirely non-native and consists of small trees, shrubs, and herbaceous plants, although there are some small native black cottonwoods and red alders.

The Tank Farm property is contaminated as a result of past industrial uses, particularly when the site served as a fuel storage and loading facility. Testing in the 1970s and 1980s found petroleum hydrocarbons, volatile organic compounds, polychlorinated biphenyls, and heavy metals in the soil, groundwater, surface water, and sediments. The Air Force conducted a cleanup of the site in the 1990s and early 2000s. They installed a groundwater remediation treatment system of fuel product recovery, vapor extraction, and air sparge subsystems. This system operated on at least a portion of the site from 1997 until 2002, when performance monitoring of groundwater and surface water indicated that contaminants were at concentrations below the site-specific cleanup levels. In 2006, Ecology concluded that the monitoring was complete and, in 2008, removed the property from the Ecology Hazardous Sites List.

The WSF discovered soil contamination on the site during archaeological investigations for the proposed action. The WSF commissioned a study of soil and groundwater contamination on the Tank Farm property in 2006. Investigations revealed elevated levels of petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylenes.

Aquatic substrates in the vicinity of the proposed terminal are primarily sand and silt. Riprap extends from the high intertidal area and extends approximately 20 feet from the shore. Substrates underneath the Tank Farm pier also contain large chunks of concrete that have fallen off the pier, as well as shell hash from shellfish that cover the pilings. The WSF did not find any eelgrass during a 2011 survey of the footprint of the proposed terminal. The nearest eelgrass beds are on either side of the Mount Baker Terminal, more than 2,000 feet east of the proposed terminal location. The dominant macroalgae species at the proposed location are sea lettuce, northern bladder chain, and kelp.

The beach is steeply sloped at this location, dropping to 30 feet below MLLW within 75 feet of the shoreline. The military dredged a birth for ships along the east side of the Tank Farm pier in the late 1940s which created elevations east of the pier approximately 38 feet below MLLW. Water depth is shallower under the Tank Farm pier, 14 feet below MLLW due to a sediment mound. The mound may have been formed by sediments that drop out of seawater as wave energy is attenuated by the dense placement of pilings underneath the pier, it may have been created deliberately to provide support for the pier, or it may have resulted from placement of dredge material from the dredge channel.

Sediment sampling in 2003 along the Tank Farm property shoreline did not detect contaminants of concern above reporting limits or above Ecology Sediment Quality Standards. However, in 2009 composite tissue samples for mussels exceeded National Toxics Rule criteria for PCBs and PAHs (Ecology 2010). Sediment sampling underneath and adjacent to the Tank Farm pier in March and April of 2012 revealed levels of contaminants above DMMP screening level criteria. Upper levels of sediment, from the surface to eight feet deep) contained chlordane, an organochlorine pesticide, and lower levels, between eight and 12 feet deep, contained PAHs.

The sediment samples were from three to five feet from the creosote piles and did not capture higher levels of PAHs that are likely to be in sediments immediately adjacent to the piles.

The Tank Farm pier substantially degrades the baseline of the action area. It is supported by 3,900 creosote-treated piles and covers 3.17 acres of Possession Sound. The pier significantly degrades water quality in the action area. Water quality is a component of both SRKW and PS Chinook salmon (PCE 5) critical habitat. Ecology estimated that there are 100,000 creosote-treated piles in the marine waters of Puget Sound (Ecology 2012). The 3,900 piles from the Tank Farm pier and the 290 piles from the existing terminal and fishing pier represent approximately four percent of all of the creosote-treated pile in Puget Sound. Ecology used data from Valle et al. (2007) to estimate the annual release of PAHs into Puget Sound. Valle et al. (2007) estimated the annual release of 0.482 kilograms (1.063 pounds) per pile. Using these numbers, NMFS estimates that these two structures release approximately 2,000 kilograms (4,400 pounds) of PAHs into Possession Sound each year.

In addition to water quality effects, the overwater shading of the Tank Farm pier further degrades PCE 5 of PS Chinook salmon critical habitat in the action area. The sharp underwater light contrasts from overwater structures cause delays in migration from disorientation, fish school dispersal (resulting in a loss of refugia), and altered migration routes around the structures (Simenstad 1999). The characteristics of an overwater structure, including height and width, orientation, and piling type and number, can affect the severity of the shade-related impacts (Southard et al. 2006). The characteristics of the Tank Farm pier, particularly its width and large number of closely space creosote piles, make it a major migration barrier to juvenile Chinook salmon.

The Tank Farm pier also impairs benthic habitat from both the area of habitat the piles occupy and the area shaded by the pier. This reduces the production of benthic and epibenthic macroinvertebrates in the action area that juvenile Chinook prey upon.

2.4 Effects of the Action

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. During consultation, neither NMFS nor the action agency identified any interrelated or interdependent actions.

The ESA prohibits the unauthorized take of threatened or endangered species, and regulations define the term "take" to include harassment. Some ESA-listed marine mammals will be harassed as they respond to sound associated with the proposed action. The ESA does not define harassment and NMFS has no regulation defining harassment. The U.S. Fish & Wildlife Service has promulgated a regulation that defines harassment as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR § 17.3). Under the Marine Mammal Protection Act, there is a definition of what is referred to as Level B harassment: "any act of pursuit, torment, or annoyance which . . . has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild" (16 U.S.C. 1362(18)(A)(ii)). This opinion considers all potential take associated with the proposed action, including the take under the more inclusive, MMPA definition of harassment.

2.4.1 Effects of the Action on Listed Species

Pile Driving and Vessel Traffic

Puget Sound Chinook Salmon and Steelhead. Pile driving can cause high levels of underwater sound. High enough levels of underwater sound can injure or kill fish and alter behavior (Turnpenny et al. 1994; Turnpenny and Nedwell 1994; Popper 2003; Hastings and Popper 2005). Death from barotrauma can be instantaneous or delayed up to several days after exposure. Even when not enough to kill fish, high sound levels can cause sublethal injuries. Fish suffering damage to hearing organs may suffer equilibrium problems, and may have a reduced ability to detect predators and prey (Turnpenny et al. 1994; Hastings et al. 1996). Hastings (2007) determined that a cumulative Sound Exposure Level (cSEL) as low as 183 dB (re: 1 μPa2-sec) was sufficient to injure the non-auditory tissues of juvenile spot and pinfish with an estimated mass of 0.5 grams.

Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Popper et al. (2005) found temporary threshold shifts in hearing sensitivity after exposure to cSELs as low as 184 dB. Temporary threshold shifts reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success.

Cumulative SEL is a measure of the sound energy integrated across all of the pile strikes. The Equal Energy Hypothesis, described by NMFS (2007), is used as a basis for calculating cumulative SEL. The number of pile strikes is estimated per continuous work period. This approach defines a work period as all the pile driving between 12-hour breaks. NMFS uses the practical spreading model to calculate transmission loss. NMFS, USFWS, and WSDOT agreed to interim criteria to minimize potential impacts to fishes (FHWG 2008). The interim criteria identify the following thresholds for the onset of physical injury using peak sound pressure level (SPL) and cSEL:

- Peak SPL: levels at or above 206 dB from any hammer strike; and
- cSEL: levels at or above 187 dB for fish sizes of 2 grams or greater, or 183 dB for fish smaller than 2 grams.

The WSF will drive all steel piles using a vibratory hammer. Vibratory pile driving does not injure fish. As described above, the WSF will impact drive a total of 34, 24-inch concrete piles for the new terminal and fishing pier between July 15 and February 15. All PS Chinook salmon and PS steelhead will be greater than 2 grams during this window, so the cumulative SEL injury threshold for this project is 187 dB. The WSF will take two hours to drive each pile. For the new terminal, impact pile driving will be completed over five days, and for the fishing pier, impact pile driving will be completed over four days.

NMFS cannot estimate the number of individuals that will experience adverse effects from underwater sound. Impact pile driving will occur episodically throughout the in-water work seasons. NMFS cannot predict the number of individual fish that will be exposed. Furthermore, not all exposed individuals will experience adverse effects. Therefore, NMFS will use the physical and temporal extent of injurious levels of underwater sound to analyze the effects to PS Chinook salmon and PS steelhead.

Laughlin (2007) measured underwater sound from the impact driving of a 24-inch concrete pile at Mukilteo ferry terminal in 2006. Noise levels were 184 dB_{peak} and 170 dB_{rms} at 10 meters from the source. NMFS calculated individual strike SEL, 159 dB_{sel}, by subtracting 25 dB from the peak dB. Using these values, NMFS calculated the distance and the area that will be subjected to cumulative SELs greater than or equal to 187dB. Impact pile driving will subject the area within 59 feet of the piles (0.5 acre) to injurious levels of underwater noise. Adult and juvenile PS Chinook salmon and PS steelhead are likely to be present at different times during this window. These fish are likely to be injured but not killed.

Southern Resident Killer Whales. NMFS is currently developing comprehensive guidance on sound levels likely to disrupt normal behaviors or cause physical injury of SRKWs. Until formal guidance is available, NMFS uses conservative thresholds of sound pressure levels from broad-band sounds known to cause behavioral disturbance (160 dB_{rms} for impulse sound and 120 dB_{rms} for continuous sound)[2] and injury (180 dB_{rms} for whales and 190 dB_{rms} for pinnipeds (70 FR 1871; January 11, 2005). Laughlin (2011) reported background noise levels at the Mukilteo Ferry Terminal within the functional hearing range for SRKWs of 122 dB_{rms}. Therefore, NMFS used 122 dB_{rms} as the threshold for this analysis.

Impact pile driving of 24-inch concrete piles will generate noise levels of 170 dB_{rms}, which is below the injury thresholds of marine mammals. However, it is above the 160 dB_{rms} disturbance threshold for disturbance for impulse sound. The noise will attenuate to below the 160 dB_{rms} disturbance threshold with 152 feet. NMFS considers the chances of SRKWs to be that within that zone during the nine days of pile driving to be extremely unlikely.

There are no data on noise from stone column construction, which uses a vibratory probe to inject gravel and crushed rock into the soil. Sound from this me is likely similar to other types of vibratory construction methods, such as pile installation, that would generate noise levels of approximately 160 dB_{rms}. The WSF will install the stone columns over a eight-week period between July 15 and September 30. Data from the Whale Museum from 1990 to 2008 show that SRKWs rarely occur in the action area during these months. Therefore, NMFS considers the

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[2] Throughout this document, the reference value for dB_{rms} is 1 μPa.

chances of SRKWs to be exposed to the noise from the stone column installation to be extremely unlikely.

Using the background noise level of 122 dB_{rms} in place of the disturbance threshold for continuous sound, the proposed vibratory pile driving activities will produce sound pressure levels that could disturb or injure marine mammals within a certain distance of the sound source. Vibratory removal of the approximately 4,200 creosote-treated timber piles will generate noise levels of up to 152 dB_{rms} exceeding the background levels of 122 dB_{rms} (Laughlin 2011). Using the practical spreading model, the noise will attenuate to background within one mile. The pile removal will take approximately 1,050 hours over three construction seasons.

Vibratory installation of the four drilled shaft casings and 91 steel piles (between 12 and 36 inches in diameter) will generate sound levels between 162 dB_{rms} and 174 dB_{rms} and will attenuate to background level between 2.9 and 18.2 miles. The vibratory installation of the drilled shaft casings and steel piles will take approximately 49.5 hours over 13 days during two construction seasons.

In general, SRKWs exposed to sound at or above 120 dB threshold (or above background levels) will respond in ways similar to those previously documented for mid-frequency hearing specialists exposed to non-pulse sound. Southall et al. (2007) conducted a comprehensive literature review of the effects of sound on marine mammals. Behavioral responses in mid-frequency cetaceans from exposure to non-pulse sound can include moderate changes in speed of travel, direction, or dive profile, moderate to extended cessation or modification of vocal behavior, minor or moderate avoidance of the sound source, and change in group distribution (Southall et al. 2007).

The SRKWs exposed to the sound of vibratory pile driving may be displaced from the portion of the action area during vibratory pile driving when noise levels are above the 122 dB background level, choosing to avoid the area in favor of less "noisy" water further away from sound sources caused by the proposed action. This could result in lost forage opportunity in those affected areas of the action area. If exposed, SRKWs are also likely to redirect around the sound instead of passing through the area. For the removal of the timber piles, the area of increased sound will be relatively small but will continue for an extended period of time. There are alternate foraging areas available, and SRKWs migrating through this area would have to travel less than a mile to avoid the disturbance (the one mile zone minus the distance from shore the SRKWs are when they encounter the underwater noise). In either case, the behavioral responses to increased noise from the timber pile removal will not reduce the reproductive success or increase the risk of physical injury or death for any individual SRKW.

For the vibratory installation of the drilled shaft casings and steel piles, the area of increased sound will be much larger but will also be 49.5 hours occurring intermittently over two six-month periods between July 15 and February 15. Forty-two percent of this window is during a time when SRKWs rarely occur in the action area. The SRKWs choosing to avoid this area during pile driving could lose foraging opportunities. However, there are alternate foraging areas available. Underwater noise from vibratory installation of the drilled shaft casings and steel piles will intermittently "block" access to Possession Sound from the south because the underwater noise will extend from Mukilteo on the mainland to Clinton on Whidbey Island. However, there will only be about 13 days with vibratory pile driving and an average of four hours of pile driving per day. Each pile will take between 30 and 60 minutes to drive. There will be breaks between piles when SRKWs could pass through the action area. Therefore, the noise from vibratory pile driving could delay migrating SRKWs for up to an hour. This is unlikely to cause a significant increase in an individual's energy budget and will not reduce the reproductive success or increase the risk of physical injury or death for any individual SRKW.

The WSF will use tugs and barges to construct the project. Tugs are slow moving, follow a predictable course, do not target whales (in the manner that whale watching vessels do), and should be easily detected by SRKWs. Vessel strikes are extremely unlikely and any potential encounters with SRKWs will be sporadic and transitory in nature. Most of the sound pressure produced by a tug towing a loaded barge will be below the level of peak hearing sensitivity for killer whales. When the tug is in motion, sound pressure levels will be transient and will attenuate to background levels a short distance from any one location. Therefore, the sound is unlikely to mask acoustic signals of biological significance to SRKWs.

Steller Sea Lions. Steller sea lions may be present during the in-water work window, October 1 to February 14. Based on the conservative thresholds described above for SRKWs, the impact pile driving of 24-inch concrete piles will generate noise levels of 170 dBrms, which is below the injury thresholds of marine mammals. Laughlin (2011) reported background noise levels at the Mukilteo Ferry Terminal within the functional hearing range for Steller sea lions of 122 dBrms. Therefore, NMFS used 122 dBrms as the threshold for this analysis.

Vibratory pile-driving will generate noise levels of up to 174 dB_{rms}, exceeding the background levels of 122 dB_{rms}. The nearest regularly used haul outs are 19 and 23 miles from the project. On any given day, it is unlikely that Steller sea lions would be foraging within the action area. However, there are sighting records of Steller sea lions within the action area. Given that the pile driving will take place over two six-month work windows, it is likely that a very small number of Steller sea lions will be exposed to underwater noise. As a result of sound exposure, Steller sea lions may spend less time foraging in the action area. In the event that animals are displaced from foraging areas in the action area, there are alternative foraging areas available to the affected individuals.

Humpback Whale. As described in the Status of the Species section, NMFS does not have fine-scale information about humpback whale use of the action area, but their occurrence there is uncommon. Based on this information, NMFS expects only a few individual humpback whales may forage or pass through the project vicinity when pile driving would occur. As described above, the impact pile driving of the concrete steel piles will not exceed the injury threshold. Laughlin (2011) reported background noise levels at the Mukilteo Ferry Terminal within the functional hearing range for humpback whales of 124 dB_{rms}. Therefore, NMFS used 124 dB_{rms} as the threshold for this analysis.

Vibratory pile driving will generate noise levels of up to 174 dB_{rms}, exceeding the background noise level of 124 dB_{rms}. Humpback whales exposed to sound at or above 120 dB_{rms} threshold (or, in this case, background levels) may elicit behavioral responses similar to previously documented responses by low-frequency hearing specialists to non-pulse sound. Noise from the vibratory pile driving will attenuate to the 124 dB_{rms} background level within 13.4 miles.

There are no studies that document the response of low-frequency sound specialists to pile driving. Humpback whales exposed to sound from the proposed pile driving are unlikely to detect the physical presence of pile driving machinery. For this reason, NMFS concludes that of the non-pulse sound sources that studied the documented response to playback sound, as opposed to studies that documented response to both sound and physical presence of machinery, are most applicable to the likely response under evaluation (Malme et al. 1983, 1984, and 1986). These studies documented responses that range from slight deviation in course and deflection around the sound (migrating whales) to avoidance of the area (feeding whales). Therefore, NMFS anticipates that if humpback whales are exposed to sound from the vibratory pile driving in the project vicinity, they may respond by either changing course to deflect around the sound (migrating whales) or by avoiding the area (feeding whales).

Similar to SRKWs, there are alternate foraging areas available, and the short delays to migration are unlikely to cause a significant increase in an individual's energy budget. Therefore, the effects are anticipated to be short-term and will not reduce the reproductive success or increase the risk of injury or mortality for any individual humpback whale.

The WSF will use tugs and barges to construct the project. They are slow moving, follow a predictable course, and do not target whales. Therefore, vessel strikes are extremely unlikely and any potential encounters with humpback whales are expected to be sporadic and transitory in nature.

Contaminants

Presently, creosote-treated piles contaminate the surrounding sediment up to two meters away with PAHs (Evans et al. 2009). The removal of the creosote-treated piles mobilizes these PAHs into the surrounding water and sediments (Smith et al. 2008; Parametrix 2011). The project will also release PAHs directly from creosote-treated timber during the demolition of the deck and if any of the piles break during removal (Parametrix 2011). The concentration of PAHs released into surface water rapidly dilutes. Smith et al. (2008) reported concentrations of total PAHs of 101.8 μg/l 30 seconds after creosote-pile removal and 22.7 μg/l 60 seconds after. However, PAH levels in the sediment after pile removal can remain high for six months or more (Smith et al. 2008). Romberg (2005) found a major reduction in sediment PAH levels three years after pile removal contaminated an adjacent sediment cap.

There are two pathways for PAH exposure to listed fish species in the action area, direct uptake through the gills and dietary exposure (Lee and Dobbs 1972; Neff et al. 1996; Karrow et al. 1999; Varanasi et al. 1993; Meador et al. 2006; McCain et al. 1990; Roubal et al. 1977). Fish rapidly uptake PAHs through their gills and food but also efficiently remove them from their body tissues (Lee and Dobbs 1972; Neff et al. 1996). Juvenile Chinook salmon prey, including amphipods and copepods, uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982). Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the Duwamish estuary.

The primary effects of PAHs on salmonids from both uptake through their gills and dietary exposure are immunosuppression and reduced growth. Karrow et al. (1999) characterized the immunotoxicity of creosote to rainbow trout (*Oncorhynchus mykiss*) and reported a lowest observable effect concentration for total PAHs of 17 μg/l. Varanasi et al. (1993) found greater immune dysfunction, reduced growth, and increased mortality compared to control fish. In order to isolate the effects of dietary exposure of PAHs on juvenile Chinook salmon, Meador et al. (2006) fed a mixture of PAHs intended to mimic those found by Varanasi et al. (1993) in the stomach contents of field-collected fish. These fish showed reduced growth compared to the control fish.

Listed fish which currently use the habitat near the three creosote-treated timber structures are likely to be exposed to PAHs. The magnitude of the exposure will greatly increase during the removal of these structures and the dredging. NMFS expects increased PAHs in the water column and sediments will remain within the area of increased suspended sediment caused by the project. Therefore, the water and substrate within 150 feet of the structure demolition (16.8 acres) and within 300 feet of the dredging (14.5 acres) will have increased levels of PAHs. Within three years after construction, the removal of the creosote-treated timber will reduce listed-fish exposure to PAHs in the long-term. Some of the listed fish exposed to PAHs from the proposed action will experience immunosuppression and reduced growth which, in some cases will increase the risk of death.

Because they are shoreline-oriented and spend a greater amount of time within the action area, juvenile Chinook salmon will have the highest probability of exposure to PAHs. However, NMFS cannot discount the probability of adult and juvenile steelhead and adult Chinook salmon exposure. NMFS cannot predict the number of Chinook salmon and steelhead that will exposed to PAHs. The numbers of each species within the action area varies year to year. NMFS also cannot estimate the proportion of fish each year that will enter the impact zones. Therefore, NMFS will use the area within 150 feet of the creosote-treated timber structure demolition and within 300 feet of the dredging as a surrogate for the number of Chinook salmon and steelhead affected.

Overwater Coverage

The project will construct three new structures with overwater coverage, the new trestle (0.35 acre), the new terminal building (0.06 acre), and the new fishing pier (0.07 acre). Overwater structures cause delays in migration for PS Chinook salmon from disorientation, fish school dispersal (resulting in a loss of refugia), and altered migration routes around the structures (Simenstad 1999). However, the project will also remove three existing structures with overwater coverage, the existing trestle (0.23 acre), the existing fishing pier (0.05 acre), and the Tank Farm pier (3.17 acres).

Overall, the project will reduce overwater coverage by 2.97 acres. This reduction will improve the ability of juvenile Chinook salmon to migrate through the action area and reduce the predation risks associated with overwater structures. The Tank Farm pier removal will also improve benthic habitat by removing the piles and shading. This will increase the production of benthic and epibenthic macroinvertebrates in the action area that juvenile Chinook prey upon.

Stormwater

As described above, the WSF will add 10.2 acres of PGIS to the existing 2.43 acres of existing PGIS. They will treat stormwater from all 12.63 acres of PGIS using Filterra systems, an enhanced stormwater BMP. Exposure to stormwater pollutants causes reduced growth, impaired migratory ability, and impaired reproduction in salmonids. The extent and severity of these effects varies depending on the extent, timing, and duration of the exposure, ambient water quality conditions, the species and life history stage exposed, pollutant toxicity, and synergistic effects with other contaminants (EPA 1980). The primary pollutants of concern in stormwater from road surfaces are total suspended solids (TSS), total zinc, dissolved zinc, total copper, and dissolved copper. Dissolved metals are particularly difficult to remove from stormwater.

The WSF used the Highway Runoff Dilution and Loading model (HI-RUN) model to predict the post-treatment annual pollutant loading, effluent concentration, and dilution zone dimensions. The HI-RUN model uses a statistical procedure called Monte Carlo simulation. Monte Carlo simulation is a method that estimates possible outcomes from a set of random variables by simulating a process a large number of times and observing the outcomes. Using Monte Carlo simulation, the HI-RUN model calculates multiple model output scenarios by repeatedly sampling values for each input variable from computer-generated probability distributions. In this way, a probability distribution can be derived for the model output that indicates which predicted values have a higher probability of occurrence. The probability of exceeding a specific threshold for detrimental effects also can be determined using this procedure. The WSF used the CORMIX dilution model for the discharges. They used a modified version of HI-RUN to calculate pollutant loadings and concentrations for the outfalls and fed that information into the CORMIX model.

Dissolved copper and dissolved zinc are the constituents of greatest concern because they are prevalent in stormwater, they are biologically active at low concentrations, and they have adverse effects on salmonids (Sandahl et al. 2007; Sprague 1968). Increased copper and zinc loading presents two pathways for possible adverse effects: direct exposure to water column pollutant concentrations in excess of biological effects thresholds and indirect adverse effects resulting from the accumulation of pollutants in the environment over time, altered food web productivity, and possible dietary exposure.

Baldwin et al. (2003) found that 30 to 60 minute exposures to a dissolved copper concentration of 2.3 µg/l over background level caused olfactory inhibition in coho salmon juveniles. Sandahl et al. (2007) found that a three hour exposure to a dissolved copper concentration of 2.0 µg/l caused olfactory inhibition in coho salmon juveniles.

The toxicity of zinc is widely variable, dependent upon concurrent levels of calcium, magnesium, and sodium in the water column (De Schamphelaere and Janssen 2004). A review of zinc toxicity studies reveals effects including reduced growth, avoidance, reproduction impairment, increased respiration, decreased swimming ability, increased jaw and bronchial abnormalities, hyperactivity, hyperglycemia, and reduced survival in freshwater fish (Eisler 1993). Juveniles are more sensitive to elevated zinc concentrations than adults (EPA 1987). Sprague (1968) documented avoidance in juvenile rainbow trout exposed to dissolved zinc concentrations of 5.6 µg/l over background levels.

The results of CORMIX modeling are shown in Table 3. This table shows the distances from each outfall where the concentrations of dissolved zinc and dissolved copper will remain above the biological effects thresholds during stormwater discharge.

Table 3.

Outfall	Receiving Water body	Dilution Zone Dissolved Zinc (ft)	Dilution Zone Dissolved Copper (ft)
Brewery Creek (4-24)	Possession Sound	21.0	12.9
Japanese Gulch (5-30)	Possession Sound	46.2	19.1
Japanese Gulch (6-XX)	Possession Sound	15.5	4.71

Because they are shoreline-oriented and spend a greater amount of time within the action area, juvenile Chinook salmon will have the highest probability of exposure to stormwater pollutants from these outfalls. However, because the project will discharge stormwater in perpetuity, NMFS cannot discount the probability of adult and juvenile steelhead and adult Chinook salmon exposure.

Juvenile Chinook salmon using the dilution zones during stormwater discharges will likely experience increased physiological stress, reduced feeding, impaired ability to detect predators, and behavior alterations. Because they are likely to migrate quickly through the action area, adult and juvenile steelhead and adult Chinook salmon will experience less exposure to dissolved copper and dissolved zinc than juvenile Chinook salmon. Juvenile steelhead will likely experience increased physiological stress, reduced feeding, impaired ability to detect predators, and behavior alterations. Adult Chinook salmon and adult steelhead exposed to stormwater discharges will experience increased physiological stress and behavior alterations (e.g. altered migration routes).

NMFS cannot predict the number of Chinook salmon and steelhead that will be exposed to the stormwater discharges. Stormwater discharges will occur in perpetuity. The numbers of each species within the action area varies year to year as does the number of rain events that produce stormwater effluent. NMFS also cannot estimate the proportion of fish each year that will enter the dilution zones. Therefore, the distance from the outfalls where dissolved copper and dissolved zinc are above the biological effects thresholds serves to quantify the exent of affected Chinook salmon and steelhead.

2.4.2 Effects on Critical Habitat

Puget Sound Chinook Salmon

The action area contains the nearshore marine PCE of PS Chinook salmon critical habitat. The essential elements of this PCE include areas free of obstruction and excessive predation with (1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation, and (2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. The effects of the proposed action include beneficial effects on the free passage, water quality, and foraging elements of the nearshore marine PCE.

As described above, the Tank Farm pier is a significant obstruction to migrating juvenile Chinook salmon. The removal of the pier will decrease total overwater coverage in the action area by 2.97 acres of overwater cover. The removal will substantially improve passage conditions within the action area.

Removal of the creosote-treated timber structures (the Tank Farm pier, the existing terminal, and the existing fishing pier) and dredging will temporarily degrade water quality by releasing PAHs and other contaminants. It will also degrade water quality near the three outfalls in perpetuity from stormwater discharges. However, removing the 7,775 tons of creosote-treated timber from the action area will substantially improve water quality in the long-term. Water quality degradation from the removal of the creosote-treated timber structures and dredging will temporarily reduce prey quantity and quality.

The stormwater discharges from the outfall on Brewery Creek will impact sand lance spawning and reduce the quantity and quality of this prey species within the action area. However, removing the 7,775 tons of creosote-treated timber and reducing shading of the nearshore by 2.97 acres will lead to a net increase in both prey quality and quantity.

Southern Resident Killer Whale

The proposed action will affect SRKW critical habitat. As described above, the proposed action will have short-term adverse effects on Chinook salmon, the primary prey of SRKWs. These adverse effects include exposure to contaminants, some of which can bioaccumulate. This will reduce survivorship for exposed juvenile Chinook salmon increase the amount of contaminants in their tissues. The long-term effects of the project will increase the quantity and quality of Chinook salmon. However, these effects to PS Chinook are unlikely to have any measurable effect on the overall quantity and quality of SRKW prey. Only a very small percentage of the PS Chinook salmon ESU will experience these adverse effects, and these individuals will only spend a very short period of time within the action area. The PS Chinook salmon ESU comprises a small percentage of the SRKW diet. Hanson et al. (2010) found only six to 14 percent of Chinook salmon eaten by SRKWs in the summer were from Puget Sound. Therefore, NMFS concludes that both the short-term adverse effects and the long-term beneficial effects on SR killer whale prey quantity and quality will be insignificant.

The sound from vibratory pile driving will interfere with SRKW passage. For example, exposed SRKWs are likely to redirect around the sound instead of passing through the area. However, as described above, the effects of the additional distance traveled is unlikely to cause a measureable increase in an individual's energy budget, and the effects would therefore be temporary and insignificant.

2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

There are no reasonably foreseeable non-Federal activities within the action area. Federal actions dominate current and future impacts in the action area because the vast majority of activities which may affect listed species in the action area will require an approval under the CWA. Future Federal actions will be subject to section 7(a)(2) consultation under the ESA. As described in section 2.3 Environmental Baseline, vessel traffic and fishing activities are the primary ongoing non-Federal activities in the action area. Specific threats from vessel traffic include the risk from strikes, behavioral disturbance, and acoustic masking. Protective regulations issued by NMFS in 2011 will minimize these threats in the action area (76 FR 20870; April 14, 2011).

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).